



Program 4

Strengthening linkages between research and development

One of IRRI's key responsibilities beyond research is to help national and international agencies engaged in socioeconomic development to disseminate new knowledge and technologies. There is also a growing understanding of the need for agricultural research institutions—such as IRRI and the other centers of the

Consultative Group on International Agricultural Research—to increasingly involve all levels of the rice production system, from farmers to policymakers, in research planning and prioritization. This inclusive, interactive approach promises to improve our understanding of farmers' and consumers' needs and how farmers evaluate scientific knowl-

edge in the context of their traditional knowledge. This, in turn, improves the probability of research success. Further, this approach can help improve efficiency in the allocation of research resources, thus reducing the chance of technologies and scientific outputs remaining unused or used only for academic purposes.

Program 4 incorporates some of the ongoing socioeconomic research on understanding rural livelihoods, assessing technology needs of farmers, and validating technologies through

farmer participatory experiments. In 2005, Project 11—*Enhancing ecological sustainability and improving livelihoods through ecoregional approaches to integrated natural resource management*—was incorporated into Project 8 (see Project 8, Output 3). This program hence now contains two projects. The first deals with research prioritization and impact assessment based on understanding farmers' needs and livelihood strategies, and interactions among technologies, infrastructure, and institutions. The second (formerly Project

12, now Project 11) aims to understand the pathways of technology dissemination, and validate and adapt promising technologies through farmer participatory research conducted in partnership with nongovernmental organizations, the private sector, and other extension agencies. This requires assessments of needs and opportunities along with innovative approaches to information dissemination and knowledge management.

PROJECT 10

Understanding rural livelihood systems for rice research prioritization and impact assessment

To effectively plan and prioritize rice research, it is essential to have a comprehensive understanding of the socioeconomic factors that influence rice producers' and consumers' circumstances and drive their decisions. Influences include people's access to and use of natural, physical, financial, human, and social resources. Further, a successful research program depends on knowledge of the influence and role of institutions that have the potential to affect lives, such as government agencies, nongovernmental organizations, and research institutions like IRRI and our national agricultural research and extension partners. If IRRI is to develop successful strategies and technologies that can help people and improve livelihoods, we must understand farmers' current practices, constraints to farmers' adoption of improved technologies

in different agroecosystems, how components of farming systems and livelihood strategies interact, and farmers' criteria for evaluating scientific knowledge. Through this knowledge, we can contribute to the formulation of improved research strategies and policies.

Also crucial for research managers and policymakers is knowledge of how policies and technologies affect the well-being of various socioeconomic groups, poverty rates, and natural resource use. Without this knowledge, it is impossible to assess progress toward meeting the objectives of rice research. Understanding the factors that drive decisions at the household level and the patterns that operate on larger geographic and time scales—such as trends



in production, pricing, and trade—can shed light on emerging rice supply-and-demand balances, competition for resources by alternative economic activities, and constraints to growth in rice production. Finally, this knowledge can reveal how best to balance research on productivity enhancement and natural resource management in various countries and ecosystems.

Output 1: Rice-sector analysis conducted and a rice statistics database maintained and shared with national agricultural research and extension systems

In 2005, we completed and published reports on the assessment of food security for Indonesia, Thailand, and Bangladesh. We now have a good understanding of the factors affecting food production, trade, and consumption and the consequent impact on household-level food security. These studies indicate that increased rice production at the national level does not necessarily assure food security at the household level. In addition to agricultural research to improve the crop productivity of resource-poor households, investments in health and education are needed for enhancing income-earning capacity.

We also completed a monograph on the impact of rice trade liberalization for the Philippines. Rice trade liberalization would have both positive and negative effects. The lower rice prices stemming from liberalization would hurt larger and wealthier farmers but would benefit poor consumers, who spend more than 20% of their income on rice.

Output 2: Rural livelihood systems studied and the interaction among technology, infrastructure, and institutions analyzed

Women play a crucial and often unappreciated role in rice production. This role is becoming even more important as increasing numbers of men are leaving the farm for off-farm employment, especially in the industrial sector. In 2005, we completed household surveys as part of a study on the *Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems*. Data collected from these surveys will be used in as-



sessing the effects of off-farm employment on agricultural productivity, farm efficiency, welfare, and the changing roles of women at the household, farm, and local levels. The results indicate that rural-to-urban migration of male labor is taking place in both irrigated and rainfed rice production systems though the rates vary. This implies that labor-saving technologies are needed for women to be able to manage the farm better and technology, information, and training should be increasingly targeted to them.

In the Indian states of Bihar and Chhattisgarh, we completed analysis of data on determinants of changes in rural livelihood systems. A household-level survey in Chhattisgarh is ongoing. In Myanmar, we completed a repeat survey to assess changes in agriculture and livelihood. The data have been processed and we are drafting a report. The first draft of the manuscript of a book on rural livelihood changes in Bangladesh has been completed. We are now working on a revision to accommodate a 2004 survey and have approached the Dhaka University Press for co-publication. The results of these studies

indicate that, although rice productivity growth generates equity-enhancing effects, other sources of income growth are also needed for overall poverty reduction.

Output 3: Constraints to the adoption of improved rice technologies assessed

A set of studies on constraints to the adoption of improved technologies and integrated farming methods in fragile ecosystems has been completed, including a study on the constraints to rice technology adoption in the rainfed lowlands of eastern India. Biophysical (field hydrology), not socioeconomic, characteristics of farm households were found to be the major determinants of farmers' choices of rice technologies. These findings indicate that rice technologies suited to the field hydrology of these unfavorable areas are needed for productivity enhancement.

Household-level surveys on “knowledge, decision making, and perceptions in the use of organic and chemical fertilizer by male and female farmers” (a collaboration with the South Korean Rural Development Administra-

tion) have been completed. These studies will determine whether there are knowledge gaps, differences in perceptions, and differences in participation in decision making in the use of organic and chemical fertilizer in rice-based farming systems in the Philippines. This study will allow us to identify strategies to enhance the capacity of women farmers in nutrient management for rice production.

Output 4: Impact of rice research on poverty alleviation and sustainable management of natural resources assessed

In 2005, we analyzed the effect of improved rice varieties biofortified with iron and zinc on disability-adjusted life years saved in Bangladesh and the Philippines. The subsequent report has been assessed and submitted to the HarvestPlus program. Investments on rice varieties with higher iron and zinc levels in the Philippines can provide substantial social rates of return. The biofortification of rice with iron or zinc is a cost-effective and sustainable approach for improving the nutritional status of iron- and zinc-deficient people. We have also conducted focus-group discussions with farmers, traders, millers, consumers, and scientists in the Philippines and Bangladesh in an effort to identify opportunities for, constraints to, and the extent of the adoption of existing improved nontransgenic rice varieties high in iron and zinc. Farmers are likely to try hybrid and biofortified rice varieties if the grain exhibits the desired characteristics. Results of this study will serve as input in the succeeding quantitative and impact study phase of HarvestPlus.

We are compiling data on rice and food consumption, disaggregated by income class and subnational boundaries, for several Asian countries where rice is the major food staple. This has



been completed for the Philippines and Bangladesh. The information will allow estimation of the regional variation in rice consumption and, consequently, the potential of iron-, zinc-, and vitamin A-fortified rice to overcome micronutrient deficiency will be analyzed at a lower geographical scale. Resulting maps can then be used to identify nutrient deficiency hotspots and target amelioration strategies.

Legislation and other initiatives that seek to improve the nutritional content of rice (e.g., brown rice) or deliver nutrients through other means (e.g., fortification of wheat flour or cooking oil, supplementation) were reviewed in 2005. We assessed the status and performance of these programs in Bangladesh and the Philippines and their potential for alleviating micronutrient deficiencies. In the Philippines, the Food Fortification Act of 2000 mandates that rice be fortified with iron. However, the costs, the fortification technology, and enforcement among millers are constraints to compliance.

An analysis of the costs and benefits of the Food Fortification Act suggests a benefit-cost ratio ranging from 0.75 to 1.55, making this program relatively expensive. Thus, other alternatives such as breeding and suitable technologies for milling to enhance and retain nutrient content need to be pursued.

Knowledge of the impact of farmers' pest control practices will have implications for the future design of pest management strategies. To better understand this, we are assessing the impact of pest management technologies in the Philippines and Vietnam.

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PROJECT 11

Facilitating rice research for impact

Developing improved rice technologies—from new varieties for cultivation through to better ways to manage a crop—is only part of the job of making rice farming more productive, more profitable, and less tedious for poor farmers, as well as reducing environmental impact. New technologies and information need to reach farmers in such a way that implementation is as easy and effective as possible. To achieve this, it is essential that the farmers themselves contribute to the process from the very beginning. Farmer feedback and participation in identifying, validating, adapting, and promoting potentially useful technologies is therefore crucial.

The challenge is enormous. Hundreds of millions of rice farmers across the world stand to benefit from improved technologies. How can we reach the greatest number possible? Further, as technologies grow more complex, they become increasingly difficult to present to farmers. Project 11 takes on this challenge by examining fundamental issues of information and technology dissemination: the problems and opportunities faced by farmers and researchers, and the optimum way to distill and present necessary and relevant messages. Through an understanding of these issues, IRRI ensures that its research focuses on what is relevant and truly helpful.



The other major piece of the puzzle is the role of the national agricultural research and extension systems (NARES). Our NARES partners—who have invaluable local, on-the-ground knowledge—are the last interface between new technologies and farmers. IRRI's partnerships with nongovernmental organizations and private-sector specialists further boost our dissemination efforts. It is vital that NARES maintain the skills needed to develop, distill, and deliver research products. It is in this light that IRRI focuses its training for NARES partners on both research and delivery methodologies to bridge the gap between technology development and its successful use.

Output 1: Develop strategies and devices for enhanced dissemination of information and knowledge-based technologies

Use and development of IRRI's Rice Knowledge Bank (RKB, www.knowledgebank.irri.org)—a comprehensive digital service containing information on rice production training and extension—continued to grow in 2005, in terms of the amount of information available, the variety of information forms suitable for different users, and the number of users. Much growth also occurred in the development of country-specific knowledge banks in which local and locally adapted RKB information is stored. In 2005, the RKB received

an average of nearly 2,000 visits per day from more than 300,000 unique visitors, almost 40,000 of whom visited more than once. The total number of hits since the RKB's inception in 2002 now exceeds 8 million, making the RKB a major contributor to global knowledge supply for the agricultural extension and research community. NARES



capacity to access and use the Rice Knowledge Bank for training and extension purposes continues to grow. The recent ADB-funded Linking Extension and Research Needs through Information Technology (LEARN-IT) program places a major emphasis on the development of the knowledge bank concept by government agencies, NGOs, and the university sector in Cambodia, Thailand, and Vietnam. We also developed 32 fact sheets on communication and impact for the RKB. These cover impact design, needs assessment, message design, formative evaluation, campaign

implementation, and communication impact assessment, and provide guidelines for NARES on scaling up dissemination and technology adoption options. The continuing plan for the RKB is to institutionalize its use in countries across the region by increasing the knowledge base and the user base, and ensuring that the information at the site remains demand-driven by user needs.

Local language materials were added to the China, Lao PDR, Myanmar, Nepal, Philippines, and Vietnam RKB sites. The Bangladesh, Nepal, and Sri Lanka RKB sites are now operational and locally controlled. In Bangladesh, an RKB field laboratory has been established under a European Commission project (Food Security for Sustainable Household Livelihoods, FoSHoL) with three nongovernmental dissemination organizations and the Bangladesh Rice Research Institute (BRRI) for providing up-to-date information for farmers and field agents. The RKB will be the hub for rice and nonrice technologies. The training material has been developed by BRRI to be used by field workers under FoSHoL. At the same time, feedback by field workers and farmers will allow us to improve the suitability of the material.

In 2005, we created a series of case studies on delivery and farmer adoption of tested technologies. These, along with lessons learned, have been stored in the RKB and widely disseminated. One of the studies, performed in collaboration with the University of Southern Mindanao, Philippines, focused on tungro virus management in North Cotabato. A book documenting the case studies is being prepared and 12 studies will be included. This resource, which distills key issues in scaling up such as processes and methodologies, organizational aspects, and impact measurement and quantification, will provide extension officers and researchers with validated

models for technology scale-up.

Postharvest training modules (consisting of fact sheets, reference manuals, teaching plans, and power point presentations) on harvesting, drying, storage, milling, grain quality, seed quality, and measurements were developed and posted on the RKB and are also available on a CD. These have been used for in-country training and partly translated into Khmer, Burmese, and Bahasa Indonesia. We also completed a postproduction e-learning course supplemented by fact sheets and manuals.

Ham (amateur) radio had success as a medium for dissemination of information and feedback between farmers and researchers in Tamil Nadu, India. The experience and observations on interactive ham radio communication were compiled and presented at a workshop in Thailand in August 2005. The approach has good potential in other rice-growing countries.

In collaboration with the University of Hawaii and the Timor-Leste Ministry of Agriculture, Forestry, and Fisheries, we developed a Tetun-language training and up-scaling manual on integrated crop management (ICM). Extension workers and crop production officers can use this for training and supporting farmers in Timor-Leste.

We collaboratively planned and implemented expansion programs in India, Indonesia, Myanmar, and Timor-Leste. These aimed to reach one in 20 farmers in areas where readiness to adopt technologies has been created or identified. The programs included up-scaling strategies for ICM in Tamil Nadu, India, and Indonesia; evaluation of the young seedling technique and ICM options in Myanmar (in collaboration with the Reaching Toward Optimal Productivity work group of the Irrigated Rice Research Consortium); and evaluation of the modified mat nursery and



ICM options in Timor-Leste (in collaboration with the University of Hawaii).

We worked with the private sector to commercialize the leaf color chart (LCC) in India and the Philippines. Validation and extension of the LCC were carried out in Timor-Leste, Iran, Bangladesh, Madagascar, Malaysia, Nepal, Pakistan, the Philippines, and Rwanda in collaboration with IRRI colleagues and local partners. The LCC method has been officially incorporated into a crop production manual in the Indian states of Tamil Nadu and Punjab. The government of Tamil Nadu has purchased and distributed to farmers 30,000 LCCs. Organizations in the Philippines, Malaysia, and Madagascar have also obtained LCCs for distribution.

The Department of Agriculture (DA) and the government of Tamil Nadu, along with the Indian Council of Agricultural Research (ICAR), have been convinced of the benefits of adopting ICM. Department of Agriculture staff are up-scaling in Tamil Nadu with state government funding and ICAR has authorized the evaluation and promotion of ICM throughout India.

Output 2: Validate technologies and methodologies for matching priority needs with available options through farmer participatory experiments and partnerships

In 2005, we documented an ICM impact project, implemented to optimize input

use, reduce production costs, increase profits, and minimize pesticide-related health and environmental risks using participatory methods, in Central Java and West Java, Indonesia. Baseline-posttest survey analysis showed that, out of seven core ICM options promoted, four were adopted by a substantial proportion of farmers. These were planting young seedlings (15–20 days old), planting 2–3 seedlings per hill at optimum spacing, reducing N-fertilizer use, and using high-yielding locally adapted rice varieties. Significant shifts in attitudes toward crop establishment and management, nutrient management, and insecticide use were also documented.

IRRI continued to bring together NARES partners to validate jointly developed LCC and ICM projects in pilot villages. Decision makers from local and national governments are involved in the design and implementation of projects from the outset. In pilot villages, LCC and ICM have improved grain yield and food output, and brought additional profit to farmers. ICM helps farmers to fully exploit the potential of modern rice varieties. These technologies have a benevolent effect on the environment and contribute to sustainability by using resources more efficiently, reducing pesticide use, and reducing nutrient losses from the soil-water-plant system. The expansion of LCC and ICM adoption has been elevated to provincial/state and national levels in Indonesia and Tamil Nadu (India). Local, state, and national governments have provided additional funds for the wider expansion of LCC and ICM.

We documented the Three Reductions, Three Gains project—which teaches farmers to reduce

their nitrogen-fertilizer rates, seed rates, and pesticide applications—in Vietnam. We initiated a Mekong-wide survey to track the diffusion of Three Reductions, Three Gains, which demonstrated how a participatory scaling-up model could achieve impact at the farmer, extension, and policy levels. Also in the Mekong Basin region, we evaluated an innovative approach using entertainment education (radio soap operas), designed to reach millions of farmers, and, as a consequence, farmers reduced their pesticide use by 38% (see Project 4).

At 125 locations in Bangladesh, we demonstrated a package of improved technologies that allow farmers to relay-crop sugarcane and rice (planting sugarcane in the same field as an established rice crop before harvesting the rice). Farmers can therefore plant sugarcane at the appropriate time without having to sacrifice the wet-season rice crop, leading to increased productivity of the available land.

In collaboration with NARES, the development and verification of hermetic sealed storage systems continued in 2005 with special focus on a hermetic storage bag, known widely as the “superbag,” that allows cereal grains to be safely stored for extended periods. We verified the bag in Lao PDR, Myanmar, and Vietnam for storing farmers’ seeds; in Indonesia, Vietnam, Myanmar, and Lao PDR for seed storage in large-scale





Output 3: Develop human capital of NARES

In 2005, we conducted or co-conducted a number of training courses and workshops. In April, we conducted training on ICM, the modified mat nursery, pests and diseases, grain quality, and postharvest management for 22 district extension and crop production staff of Timor-Leste in collaboration with the University of Hawaii in April 2005. IRRI's Rice Production Course ran twice in 2005, and was attended by 14 participants from Asia and seven from Africa. The course maintains its popularity with NARES in both Asia and Africa. A grain quality and rice production course was conducted in Sri Lanka in May/June. We conducted in-country rice production training in Antsohihy, Madagascar, in

collaboration with two consultants and the Aga Khan Foundation in May, and a special rice production course and study tour for 10 Bangladeshi participants were conducted in November/December. We presented the *Scientific Writing and Presentation Skills Course* to 25 Tamil Nadu Agricultural University (TNAU) scientists at TNAU in June.

hermetic systems (5-ton capacity) for seed producers or farmer groups; and in Myanmar for the storage of commercial grains at trader and miller levels. Results showed that, by using these bags or other hermetic storage systems, farmers are able to control grain moisture levels, control grain pests without using chemicals, maintain seed germination and viability for a much longer period, and maintain grain quality longer. Hermetic storage is especially promising for improving the quality of farmers' seeds, for maintaining the quality of seed producers' seeds, and preventing pest infestation and extending the shelf life of brown rice. The bags can also be used for other commodities such as maize, coffee, pulses, and peanuts. In Indonesia, a local manufacturer has started making the *Kantong Semar*, a local version of the superbag, which has a performance similar to that of the original IRRI bag but does not need to be imported.



Since then, these staff have themselves conducted training courses on scientific writing and presentation skills at 10 locations throughout Tamil Nadu.

Hands-on rice mill evaluation training was conducted in Vietnam, Indonesia, and Myanmar, evaluating two rice mills in Vietnam, three in Indonesia, and one in Myanmar. The course in Indonesia led to recommendations for rice mill improvement and better understanding of the milling process and quality issues.

In collaboration with the International Potato Center, IRRI developed and conducted a course on *Participatory Research and Extension*. Participants were from IRRI and NARES research projects. We are developing a guidebook on *Participatory planning frameworks for facilitating interdisciplinary research in rice resource management*, which has been externally reviewed and is being edited for publication. The book describes the frameworks, models, and techniques used to facilitate interdisciplinary collaboration with a wide range of stakeholders at different levels, and which are applicable for communication and diffusion of technology options.

In January 2006, the Indonesian Minister of Agriculture declared the implementation of site-specific nutrient management (SSNM) in 21 provinces as recommended by the Indonesian Agency for Agricultural Research and Development. The Indonesian Institute for Rice Research has adopted the ICM approach for rainfed lowland and upland rice. More than 200 extension agents and farmers were trained in SSNM principles and using the LCC in West Java, Bali, and Banten provinces.

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